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PHASE SENSITIVE AMPLIFICATION WITH SIS

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M F BOCKO 28 MAR 88

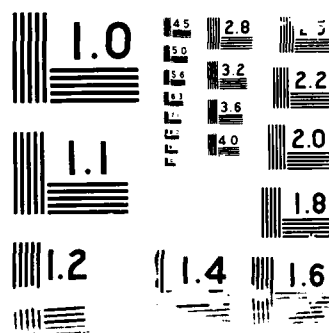
UNCLASSIFIED

AFOSR-TR-88-0452 AFOSR-87-0131

F/G 9/1

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DOCUMENTATION PAGE

Form Approved
OMB No. 0704-018

AD-A194 594

DTIC
ELECTE

DATE 03 1988

1b. RESTRICTIVE MARKINGS

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release,
distribution unlimited

2b. DECLASSIFICATION / DOWNGRADING

4. PERFORMING ORGANIZATION REPORT NUMBER(S)

QD

5. MONITORING ORGANIZATION REPORT NUMBER(S)

AFOSR-TR- 88-0452

6a. NAME OF PERFORMING ORGANIZATION

Univ of Rochester

6b. OFFICE SYMBOL
(if applicable)

7a. NAME OF MONITORING ORGANIZATION

AFOSR/NE

6c. ADDRESS (City, State, and ZIP Code)

Dept of Electrical Eng
Univ of Rochester

7b. ADDRESS (City, State, and ZIP Code)

Bldg. 410
Bolling AFB, DC 20332-64488a. NAME OF FUNDING / SPONSORING
ORGANIZATION

AFOSR

8b. OFFICE SYMBOL
(if applicable)

NE

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

AFOSR-87-0131

8c. ADDRESS (City, State, and ZIP Code)

Bldg. 410
Bolling AFB, DC 20332-6448

10. SOURCE OF FUNDING NUMBERS

PROGRAM
ELEMENT NO.

61102F

PROJECT
NO.

2305

TASK
NO.

C3

WORK UNIT
ACCESSION

11. TITLE (Include Security Classification)

PHASE SENSITIVE AMPLIFICATION WITH SIS QUASIPARTICLE MIXERS

12. PERSONAL AUTHOR(S)

Dr. Bocko

13a. TYPE OF REPORT

Annual

13b. TIME COVERED

FROM 5 Jan 87 TO 14 Jan 88 Mar 28, 1988

14. DATE OF REPORT (Year, Month, Day)

15. PAGE COUNT

1

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD

GROUP

SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

We have obtained the SIS junctions and RF choke structures which we will use in our experiments. These were fabricated for this project by Dr. Michael Cromar at the National Bureau of Standards Cryoelectronics Laboratory in Boulder Colorado. We have measured the DC characteristics of these junctions and have found that they have low leakage currents and RC products that are very close to our design goal. We have made preliminary calculations of the SIS mixer conversion efficiency for the real DC characteristics of our junctions and find that the results show the required phase sensitive response.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT

☐ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION

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22c. OFFICE SYMBOL

NE

DD Form 1473, JUN 86

Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

Technical Report: Grant No AFOSR-87-0131
"Phase sensitive amplification with
SIS quasiparticle mixers"
Mark F. Bocko
Department of Electrical Engineering
University of Rochester

Date: March 28, 1988

In the first year of this grant we have developed a new theoretical framework to predict the behavior of resistive mixers which are pumped by two local oscillators. We have shown that an ideal Superconductor-Insulator-Superconductor tunnel junction mixer which is pumped by two local oscillators can have phase sensitive conversion efficiency. For example, there can be conversion gain for the "cosine" phase of an incoming electromagnetic wave and complete insensitivity to the "sine" phase. Such behavior is required to be able to achieve a mixer noise temperature below the conventionally believed quantum mechanical limit. In the limit of zero power in one of the local oscillators our theory agrees with the conventional quantum theory of mixing. An explicit calculation of the noise of a double pumped mixer is presently under way.

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We have obtained the SIS junctions and RF choke structures which we will use in our experiments. These were fabricated for this project by Dr. Michael Cromar at the National Bureau of Standards Cryoelectronics Laboratory in Boulder Colorado. We have measured the DC characteristics of these junctions and have found that they have low leakage currents and RC products that are very close to our design goal. We have made preliminary calculations of the SIS mixer conversion efficiency for the real DC characteristics of our junctions and find that the results show the required phase sensitive response.

The remainder of the experiment is under construction. Our dewar is being built by Infrared Laboratories and a phase coherent, three-frequency millimeter wave source is being constructed for us by Millitech. The mixer block will be a superconducting niobium cavity and is now being designed.

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